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U. S. ARMY TEST AND EVALUATION COMMAND
DEVELOPMENT TEST II(ST) -- SERVICE TEST OPERATIONS PROCEDURES

AMSTE-RP-702-102

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*Test Operations Procedure 3-3-067
AD 757839

SIGHT, INDIRECT FIRE

		<u>Paragraph</u>	<u>Page</u>
Section I.	GENERAL		
	Purpose and Scope	1	1
	Background	2	2
	Equipment and Facilities . . .	3	2
II.	TEST PROCEDURES		
	Supporting Tests	4	3
III.	SUPPLEMENTARY INSTRUCTIONS		
	Personnel Training	5	6
	Mounting and Seating	6	6
	Sight Calibration	7	8
	Laying the Weapon, Sight Setting, and Relaying	8	9
APPENDIX.	REFERENCES		12

SECTION I
GENERAL

1. Purpose and Scope.

a. The procedures described in this test operations procedure apply to all indirect fire sights used as components of appropriate Infantry weapons. The test methods and data analysis techniques established in this TOP may be used to evaluate the features and characteristics prescribed in the applicable requirements documents, and to determine whether the test item is suitable for use by the United States Army.

b. This document calls for certain tests to be conducted in realistic tactical environments, to include simulated combat conditions when appropriate. It does not include environmental testing for extreme climatic conditions, although observations of the climatic conditions prevailing during the service tests should be made to provide a record for future evaluation.

*This TOP supersedes MTP 3-3-067, 3 August 1970, including all changes.

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12 February 1973

c. These test procedures provide measures to evaluate the physical characteristics and serviceability of a test item. They also describe a series of appropriate tests designed to examine a test item's operational and functional performance characteristics, and examine the human factors and value engineering aspects of the test item.

d. The environmental conditions applicable to this document are those associated with climatic categories 5 and 6 specified in AR 70-38, Research, Development, Test and Evaluation of Materiel for Extreme Climatic Conditions.

e. As used herein, the night environment is defined as: full moon, 1×10^{-2} to 4×10^{-2} foot candles; half moon, 1×10^{-3} to 4×10^{-3} foot candles; starlight, 1×10^{-4} to 4×10^{-4} foot candles; overcast, 1×10^{-5} to 4×10^{-5} foot candles; dawn and dusk, 1 to 10 foot candles; and twilight, 1×10^{-1} to 10 foot candles.

2. Background.

a. Mortars can be accurately aimed by using the precision sights which have been developed in the last quarter of a century and to which improvements are constantly being made. The sights, basically, are telescopes that contain the following features: crossed lines etched on one of its internal glass disks (the reticle pattern is numbered in mils and can be illuminated for night operations); a scale calibrated in mils that indicates the direction in which the telescope is pointing; another scale, also calibrated in mils, that measures the angle of the sight in relation to the ground; and a mount which consists of a horizontal latch, a male dovetail, and a locking device. The sights must be constructed so that they can be quickly and properly mounted or dismounted from a mounting bracket (or mounting standard) located on the mortar itself. The mounting and dismounting of the sight should not cause any delay to a crew which is trying to emplace or displace a mortar in the shortest possible time. Once the sight has been mounted on the mortar, any movement of the mortar barrel will move the sight.

b. The indirect fire sight is used primarily for delivering accurate high angle fire on a target which is not itself used as a point of aim for the weapon. A secondary use of the sight is to orient the weapon by aiming through the sight directly at the target.

3. Equipment and Facilities.

- a. Test item, with appropriate ancillary equipment and weapon.
- b. Control sight, if applicable, with appropriate ancillary equipment and weapon.

- c. Suitable firing ranges and appropriate targets.
- d. Range instrumentation and recording equipment.
- e. Ammunition.
- f. Safety and first aid equipment.
- g. Photographic equipment (still and motion picture).
- h. Communications equipment.
- i. Military ground vehicles, as required.
- j. Binoculars.
- k. Boresight equipment.
- l. Aiming circle and accessories.
- m. Compass.
- n. Stopwatches.
- o. Cleaning materials and lubricants.
- p. Night television, as appropriate.
- q. Meteorological equipment for measuring temperature, temperature gradient, atmospheric pressure, relative humidity, precipitation, and wind speed and direction.
- r. Photometer, for measuring light level readings.
- s. Individual CB protective clothing and equipment.

SECTION II TEST PROCEDURES

4. Supporting Tests.

A. Although the proposed testing procedures are described in successive paragraphs, some may overlap or may be performed concurrently. The arrangement of supporting tests is flexible and allows the test officer an opportunity to tailor a test plan to the precise characteristics and requirements of a specific test item, methodology, and the state-of-the-art at

12 February 1973

the time and place of testing. Detailed specific test procedures will be dependent on the characteristics of the test item and the stated criteria in the applicable requirements documents.

b. In his preparations, the test officer should conduct the necessary administrative, personnel, and supply preliminaries outlined in his test officer guide or manual, or in his unit or organizational standard operating procedures. He must keep in mind the fact that sufficient pre-test training must be accomplished to ensure the test soldiers are equally familiar with both the test and control items. It is extremely important that the performance of the test sight not be degraded because the test troops were unfamiliar with it. He should also review TOP 3-3-050, Mortars, to become familiar with those aspects of the weapon which might have a direct bearing on his own testing program.

c. Whenever possible, the test item should be compared to an appropriate control item. The selected control indirect fire sight should be a standard inventory sight, related as close as possible characteristically to the test sight. To aid in obtaining a valid comparison, the control sight should be in new or nearly new condition and subjected to the same care and maintenance considerations as the test sight throughout the conduct of the testing program.

d. The test officer must also ensure that during each of the supporting tests sufficient data will be collected to enable him to arrive at valid conclusions. To determine the best way to collect sufficient data, the test officer should consult with methodology personnel, e.g., statistical analysts, experimental psychologists, human factors analysts, to develop a proper experimental design to include the techniques for random sampling, the sample sizes required to evaluate true performance, the estimation of average performance (or variability of performance) from a sample, the comparison of materials or products with respect to average performance (or variability of performance), the number of test soldiers needed, and the number of repetitions required for a specific exercise. Statistical guidance can be found in TOP 3-1-022, Confidence Intervals and Sample Size, and in National Bureau of Standards Handbook 91, Experimental Statistics.

e. A log book should be maintained as a chronological record of remarks, observations, meteorological data, times, comparisons, and other pertinent events and data. An accurate compilation will expedite the collation of the information required to support each finding. Photographs, motion pictures, charts, graphs, and other pictorial or visual aids are suggested as supplementary evidence to narrative reports.

f. Meteorological data and light level readings in situations where such data may have a bearing on the test results should be collected.

g. When risk analysis is directed, TECR 70-34, Risk Analysis for

12 February 1973

TOP 3-3-067

Suitability Tests, will be followed.

h. Published common service TOPs, other published documents, and the supporting tests listed below, which are further defined where necessary in Section III, should be considered in the formulation and development of a service test plan. Additional reference material is listed in the appendix.

<u>TEST SUBJECT TITLE</u>	<u>PUBLICATION NO.</u>
(1) Preoperational Inspection and Physical Characteristics	3-3-500
(2) Safety	3-3-517
(3) Personnel Training (refer to para 5)	
(4) Mounting and Seating (refer to para 6)	
(5) Sight Calibration (refer to para 7)	
(6) Laying the Weapon, Sight Setting, and Relaying (refer to para 8)	
(7) Security From Detection	1-3-515
(8) Man Portability/Transportability	10-3-506
(9) Airdrop Operations	7-3-511
(10) Compatibility with Related Equipment	4-3-519
(11) Adverse Conditions	3-3-524
(12) Maintenance Evaluation	10-3-504 and TECR 750-15
(13) Durability and Reliability	10-3-502
(14) Human Factors Engineering	3-3-521
(15) Value Engineering	TECR 700-1

12 February 1973

SECTION III
SUPPLEMENTARY INSTRUCTIONS

5. Personnel Training.

a. MTP 3-3-501, Personnel Training, outlines the general procedures that should be followed to determine the type and duration of the instruction required to train test soldiers in the use of the particular test sight, whether a proposed program of instruction is adequate to develop proficiency in the use of the test sight, and whether the test item meets the training criteria contained in the appropriate requirements documents. If the test officer determines a proposed program of instruction is inadequate, he should draw therefrom specific conclusions and formulate detailed recommendations for improving the adequacy of the program.

b. The test soldiers should be fully qualified mortar gunners and mortar crewman and should be matched as closely as possible with respect to their marksmanship qualifications, experience, and visual acuity. Soldiers with a night blindness condition should not be used.

c. The test officer must ensure the test soldiers clearly understand what is to be accomplished during the testing program, and that the test soldiers are sufficiently trained and oriented in the use of the test and control sights and related weapons to provide for a safe, objective, and thorough test situation.

6. Mounting and Seating.

a. Objectives.

(1) To determine the ease and simplicity of mounting and locking the test sight on the weapon.

(2) To determine the firmness and retention of the seating.

(3) To determine the ease and simplicity of detaching the test item from the weapon.

b. Method.

(1) Exercises should be conducted during which the test soldiers repeatedly remove the test sight from its carrying case, mount the test sight on the weapon, check the locking and seating of the test sight on the weapon and then detach the test item from the weapon, replacing it in its carrying case. The procedures for accomplishing the mounting and removal of the sight should be those outlined in the preliminary operating and maintenance manual (POMM) or in the applicable field manuals.

(2) These exercises should also be conducted under conditions of reduced visibility, at night, and when the test soldiers are wearing gloves and items of individual CB protective clothing and equipment.

(3) Each mounting, checking, and detaching exercise should be timed and note made of any difficulties encountered.

(4) All mounting, checking, and detaching exercises should be repeated using the control item, if applicable, and the same test soldiers.

c. Data Required. The following will be recorded for each mounting, checking, and detaching exercise:

(1) Weapon and sight identification.

(2) Test soldier identification.

(3) Conditions of test (day, night, weather, clothing worn, and equipment).

(4) Procedures used.

(5) Time to mount and check the sight.

(6) Time to detach the sight.

(7) Difficulties encountered.

(8) Comments, opinions, and observations of test soldiers and test supervisors.

d. Analytical Plan.

(1) Mean times will be calculated from each type of timed exercise by test conditions and the type of sight used.

(2) Upper and lower confidence limits for mean times will be established and compared with the values prescribed in the appropriate requirements documents.

(3) Data will be tested for normality and, if normal, an appropriate statistical test will be used to determine if there is a significant difference between the times required to conduct each exercise with the test item and the control item. If the data is not normal, a non-parametric analysis will be performed.

12 February 1973

(4) An appropriate subjective analysis of the comments, observations, and opinions expressed by the test participants should be prepared.

(5) The results should be presented in narrative form supplemented, as appropriate, with tables, charts, graphs, photographs, and motion pictures.

7. Sight Calibration.

a. Objective. To determine the ease of accurately calibrating the test sight with the weapon by using the various standard methods of calibration.

b. Method.

(1) Exercises should be conducted in which the test soldiers calibrate the test sight with the weapon, using each of the various authorized methods. These methods should include calibrating with the boresight device for elevation and deflection, with the compass for elevation with the gunner's quadrant for elevation, and with the aiming circle for deflection.

(2) These exercises should also be conducted during periods of reduced visibility, at night, and when the test soldiers are wearing gloves and items of individual CB protective clothing and equipment.

(3) Each calibration exercise should be timed and note made of any difficulties encountered.

(4) All calibration exercises should be repeated using the control item, if applicable, and the same test soldiers.

(5) Sight calibration will also be checked during and after all firing exercises to determine if the shock of firing affects sight calibration or the course and micrometer scale settings.

(6) Note should also be made if special tools are required for sight calibration.

(7) Comments, opinions, and observations of test participants will be recorded.

c. Data Required.

(1) Weapon and sight identification.

(2) Test soldier identification.

(3) Conditions of test (day, night, weather, clothing and equipment).

(4) Calibration procedures and instruments used.

(5) Time required for calibration.

(6) Accuracy of calibration.

(7) Difficulties encountered, and special tools required.

(8) Observations, opinions, and comments of test personnel.

d. Analytical Plan.

(1) Mean times will be calculated for each type of timed exercise by test conditions, the type of sight, and the calibration procedure used.

(2) Upper and lower confidence limits for mean times will be established and compared with the values prescribed in the appropriate requirements documents.

(3) Data will be tested for normality and, if normal, an appropriate statistical test will be used to determine if there is a significant difference between the times required to conduct each exercise with the test and control items.

(4) An appropriate subjective analysis of the comments, observations, and opinions expressed by the test participants should be prepared.

(5) The results should be presented in narrative form supplemented, as appropriate, with tables, charts, graphs, photographs, and motion pictures as appropriate.

8. Laying the Weapon, Sight Setting, and Relaying.

a. Objectives.

(1) To determine the ease of initially laying the weapon for evaluation and direction.

(2) To determine the ease, speed, and accuracy of setting the sight and relaying the weapon upon receipt of fire command data.

b. Method.

(1) Weapon crews composed of test soldiers should conduct initial laying exercises with weapons on which the test sights are mounted, using

12 February 1973

prescribed crew drill procedures and techniques.

(2) The weapon crews should also conduct both firing and non-firing sight setting, reciprocal laying, and relaying exercises with weapons on which the test sights are mounted, using proper crew drill procedures and acquired fire command data. Exercises should include manipulations for both traversing and searching fires, and for target engagement by the direct lay method.

(3) The exercises should be repeated during periods of reduced visibility, at night, and with test soldiers wearing gloves and items of individual CB protective clothing and equipment.

(4) Each exercise should be timed and note made of any difficulties encountered.

(5) Identical exercises should be conducted using the control sight, if applicable, and the same test soldiers.

(6) A series of suggested tactical exercises is included as an appendix in TOP 3-3-050, Mortars. Seven different field exercises are described. They include situations a mortar squad could expect to encounter in both offensive and defensive tactical situations. If the exercises are used, they should be conducted using both the test and control mortar sights, and both should be subjected to the exercises concurrently from the same general locations.

c. Data Required.

- (1) Weapon and sight identification.
- (2) Test soldier identification.
- (3) Conditions of test (day, night, weather, clothing and equipment).
- (4) Identification as a firing or nonfiring exercise.
- (5) Time for initial lay, reciprocal lay, and each relay.
- (6) Difficulties encountered.
- (7) Effects of weapon firing on sight seating, sight setting, and sight calibration.
- (8) Observations, opinions, and comments of test soldiers and test supervisors.

d. Analytical Plan.

- (1) Mean times will be calculated for each type of exercise by test conditions and type of sight used.

(2) Upper and lower confidence limits for mean times will be established and compared with the values prescribed in the appropriate requirements documents.

(3) Data will be tested for normality, and, if normal, an appropriate statistical test will be used to determine if there is a significant difference between the times required to conduct each exercise with the test and control sights.

(4) An appropriate subjective analysis of the comments, observations, and opinions expressed by the test participants should be prepared.

(5) The results should be presented in narrative form supplemented, as appropriate, with tables, charts, graphs, photographs, and motion pictures, as appropriate.

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APPENDIX
REFERENCES

1. AR 70-10, Test and Evaluation During Development and Acquisition of Materiel.
2. AR 70-38, Research, Development, Test and Evaluation of Materiel for Extreme Climatic Conditions.
3. National Bureau of Standards Handbook 91, Experimental Statistics.
4. FM 23-85, 60-mm Mortar, M19.
5. FM 23-90, 81-mm Mortar, M29.
6. FM 23-91, Mortar Gunnery.
7. FM 23-92, 4.2-inch Mortar, M30.
8. TECR 70-23, Equipment Performance Reports.
9. TECR 70-24, Documenting Test Plans and Reports.
10. TECR 385-6, Verification of Safety of Materiel During Testing.
11. TECR 700-1, Quality Assurance: Value Engineering.
12. TECR 750-15, Maintenance Evaluation During Testing.
13. TOP 1-1-008, Tropic Environmental Considerations.
14. TOP 1-1-012, Classification of Deficiencies and Shortcomings.
15. TOP 1-1-019, Testing Armament and Individual Weapons.
16. TOP 1-1-041, Air Portability and Airdrop Service Testing.
17. TOP 1-1-045, General Supplies and Equipment Testing.
18. TOP 1-1-046, Field Combat Test Exercises.
19. MTP 3-2-050, Mortars.
20. MTP 3-3-116, Sight, Indirect Fire.
21. MTP 3-3-506, Accuracy and Precision.
22. MTP 3-4-001, Desert Environmental Test of Armament and Individual Weapons.
23. MTP 3-4-003, Armament and Individual Weapons (Tropic).
24. MTP 3-4-008, Arctic Environment Test, Indirect Fire Weapons (Mortar).

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